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The Incidence of Rhegmatogenous Retinal Detachment in Kumamoto, Japan between 2009 and 2011

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Abstract

Objective: The annual incidence of rhegmatogenous retinal detachment (RRD) in Kumamoto, Japan was previously evaluated in 1990. However, the incidence has not been evaluated during the last 20 years. The purpose of this study was to estimate the current incidence and epidemiologic characteristics of RRD in Kumamoto, Japan.

Methods: The study was based on a retrospective chart review of hospital patients living in Kumamoto, Japan. All patients were treated for primary RRD by conventional surgery (pars plana vitrectomy and/or scleral buckling) at Kumamoto University Hospital or Ideta Eye Hospital between January 1, 2009, and December 31, 2011. Information on age, gender, refractive status, and history of cataract surgery was collected.

Results: A total of 897 RRD patients were identified during the 3-year study period. The annual incidence of RRD was 16.5 (21.9 in males, 11.7 in females) per 100,000 people, with a peak incidence of 35.4 in the 50-59 years of age group. The incidence of RRD in males was 1.88 times (95% confidence interval, 1.56-2.29) higher than in females (P<0.0001). Prior cataract extraction was found in 14% of RRD eyes. Myopia (≤ −1 diopter [D]) was found in 54%, and high myopia (≤ −6 D) was found in 23%. The mean refraction status was −3.53 ± 3.94 D. The mean refractive status in patients younger than 50 years of age (−6.00 ± 3.33 D) was significantly higher than that in patients 50 years of age or older (−2.23 ± 3.61 D; P<0.001). The incidence of RRD in Kumamoto is expected to increase over the next 20 years in comparison to a previous study investigated in 1990.

Conclusion: The annual incidence of RRD was dependent on age, gender, refraction status, and history of cataract surgery. Considering the growing elderly population, we expect that the incidence of RRD will continue to increase in Japan.

Keywords: Rhegmatogenous retinal detachment; Myopia; Cataract surgery; Refraction

Introduction

Rhegmatogenous retinal detachment (RRD) is a blinding disease characterized by the separation of the inner neurosensory retina from the outer retinal pigment epithelium due to a break in the retina. Fluid accumulates in the subretinal space through the break in the retina, and the decreasing function of the neurosensory retina leads to vision loss.

Previous studies have reported that the annual incidence of RRD was 7.98-18.2 per 100,000 people [1-7]. Because the incidence of RRD is influenced by demographic characteristics [8], severe myopia [9,10], and history of cataract surgery [11,12], the incidence varies widely by region and age group. In Japan, a previous retrospective study reported that the incidence of RRD in Kumamoto Prefecture was 10.4 per 100,000 people (9.6 in males, 11.2 in females) [3]. However, this study was conducted in 1990, and the demographic characteristics in Kumamoto have changed during the last 20 years. To date, some studies have reported the incidence of RRD over a 20-year period [4,6]; however, no studies have compared the 20-year data with the data from the same region 20 years previously in an Asian population.

To prevent permanent vision loss, patients with RRD require therapeutic surgery. Pars plana vitrectomy and/or scleral buckling are generally performed to treat RRD. In Kumamoto, almost all therapeutic surgeries for RRD are performed at Kumamoto University Hospital or Ideta Eye Hospital because there were only two hospitals which have the availability of adequate surgical apparatus and instruments for RRD. Therefore, we conducted this study to evaluate the current incidence of RRD in Kumamoto by examining the RRD patients who required surgical intervention in Kumamoto University Hospital or Ideta Eye Hospital between 2009 and 2011.

Materials and Methods

This study was based on a retrospective chart review of hospital patients living in Kumamoto Prefecture, Japan. All patients were treated for primary RRD by conventional surgery (pars plana vitrectomy and/or scleral buckling) at Kumamoto University Hospital or Ideta Eye Hospital between January 1, 2009, and December 31, 2011. RRD was defined as retinal elevation with any retinal break

found before or during surgery. The exclusion criteria were as follows: tractional, exudative, or traumatic retinal detachment; solely retinal photocoagulation or cryotherapy; recurrent RRD; retinal detachment after vitrectomy; and contralateral RRD surgery within the study period. Information on age, gender, refractive status, and history of cataract surgery was collected. To calculate the annual incidence rate of RRD in Kumamoto Prefecture, we used the data based on the 2010 population census of Kumamoto, Japan.

All data are presented as the mean ± standard deviation. Pearson's chi-squared test was used to examine the differences in the incidence of RRD between genders for different age groups, and the Mann-Whitney *U*-test was used to examine the differences in the refractive status by age and sex distribution. All of the statistical analyses were conducted using the JMP 10 software program (SAS Institute, Cary, NC, USA). The threshold for significance was $P<0.05$.

This study was approved by the Institutional Review Board of Kumamoto University Hospital and Ideta Eye Hospital, and all study protocols adhered to the Declaration of Helsinki. In accordance with the Japanese Ministry of Health, Labor and Welfare Guidelines for Clinical Research, the patients were informed of the study design through the hospital website.

Results

A total of 897 cases (62% male) of RRD patients who required surgical intervention were identified during the 3-year study period. All patients were Japanese. The number of RRD patients was 293 (33%) in 2009, 275 (31%) in 2010, and 329 (37%) in 2011. Pars plana vitrectomy was performed for 570 patients (64%), scleral buckling was performed for 295 patients (33%), and both pars plana vitrectomy and scleral buckling were performed for 32 patients (3.6%). The mean age of all patients was 54.4 ± 15.5 years (range, 6-95 years). The annual incidence of RRD was 16.5 per 100,000 people (95% confidence interval [CI]=15.0-18.1).

Age and gender distribution

The mean age of males with RRD was 54.4 ± 15.5 years (range, 6-95 years), and that for females was 54.4 ± 15.3 years (range, 15-87 years). The annual incidence of RRD was 21.9 per 100,000 people among males and 11.7 per 100,000 people among females. The peak incidence was found at 50-59 years of age, with an incidence of 35.4 per 100,000 people. The second-highest peak was found at 20-29 years of age, with an incidence of 10.0 per 100,000 people (Table 1 and Figure 1). The incidence of RRD among males was 1.88 times (95% CI=1.56-2.29) higher than females ($P<0.0001$). In the subpopulations, the incidence in males was significantly higher than in females for 30-39 years of age (2.61 times; 95% CI=1.41-4.85; $P=0.0016$), 40-49 years of age (1.95 times; 95% CI=1.37-2.78; $P=0.0002$), 50-59 years of age (1.51 times; 95% CI=1.18-1.92; $P=0.0009$), 60-69 years of age (1.89 times; 95% CI=1.46-2.49; $P<0.0001$), and 70-79 years of age (2.93 times; 95% CI=1.89-4.54; $P<0.0001$) (Table 1).

	Total			Male			Female				
Age (years)	**Population* (%)**	**No. patients (%)**	**Incidence†**	**Population* (%)**	**No. patients (%)**	**Incidence†**	**Population* (%)**	**No. patients (%)**	**Incidence†**	**Male-to-female ratio (95% CI)**	***P*-Value**
0-9	161.3 (8.9)	1 (0.1)	0.2	82.6 (9.7)	1 (0.2)	0.4	78.7 (8.2)	0 (0.0)	0.0	N/A	
10-19	179.0 (9.8)	32 (3.6)	6.0	92.1 (10.8)	22 (3.9)	8.0	86.9 (9.0)	10 (3.0)	3.8	2.08 (0.98-4.39)	0.050
20-29	179.7 (9.9)	54 (6.0)	10.0	87.7 (10.3)	30 (5.4)	11.4	92.0 (9.5)	24 (7.1)	8.7	1.31 (0.77-2.24)	0.32
30-39	217.8 (12.0)	49 (5.5)	7.5	106.5 (12.5)	35 (6.3)	11.0	111.3 (11.5)	14 (4.2)	4.2	2.61 (1.41-4.85)	0.0016‡
40-49	212.7 (11.7)	133 (14.8)	20.8	101.2 (11.9)	85 (15.2)	28.0	111.5 (11.6)	48 (14.2)	14.3	1.95 (1.37-2.78)	0.0002‡
50-59	253.5 (13.9)	269 (30.0)	35.4	123.2 (14.4)	158 (28.2)	42.7	130.3 (13.5)	111 (32.9)	29.2	1.51 (1.18-1.92)	0.0009‡
60-69	245.7 (13.5)	233 (26.0)	31.6	116.8 (13.7)	147 (26.3)	41.9	128.8 (13.4)	86 (25.5)	23.5	1.89 (1.46-2.49)	<0.0001‡
70-79	202.1 (11.1)	93 (10.4)	15.3	86.9 (10.2)	64 (11.4)	24.6	115.3 (12.0)	29 (8.6)	10.7	2.93 (1.89-4.54)	<0.0001‡
80-89	126.7 (7.0)	31 (3.5)	8.2	44.5 (5.2)	16 (2.9)	12.0	82.1 (8.5)	15 (4.5)	7.7	1.97 (0.97-3.98)	0.055
90 ≤	27.9 (1.5)	2 (0.2)	2.4	6.0 (0.7)	2 (0.4)	11.0	21.8 (2.3)	0 (0.0)	1.5	N/A	
Indeterminate	11.1 (0.6)	0 (0.0)	N/A	6.0 (0.7)	0 (0.0)	N/A	5.2 (0.5)	0 (0.0)	N/A	N/A	
Total	1817.4 (100)	897 (100)	16.5	853.5 (100)	560 (100)	21.9	963.9 (100)	337 (100)	12.4	1.88 (1.56-2.29)	<0.0001‡

CI: Confidence Interval; N/A: Not Applicable; *The numbers of patients are expressed in the thousands. The data are based on the 2010 population census of Kumamoto, Japan; †The data are expressed as the annual incidences per 100,000 people; ‡$P<0.05$

Table 1: The numbers of population and incidences of rhegmatogenous retinal detachment in Kumamoto prefecture between 2009 and 2011.

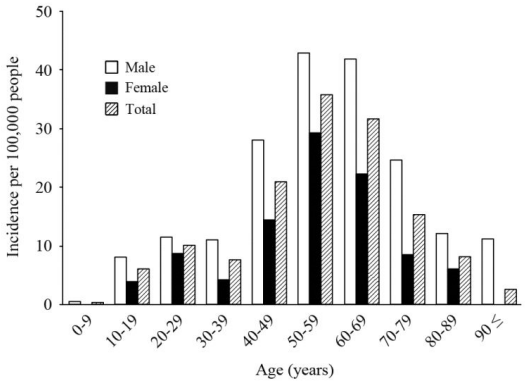

Figure 1: The annual incidence of rhegmatogenous retinal detachment per 100,000 people in Kumamoto by age group between 2009 and 2011.

RRD in phakic eyes and eyes with prior cataract extraction

Of the 897 patients, RRD in phakic eyes was found in 773 (86%), and RRD in eyes with prior cataract extraction was found in 122 (14%). The proportion of eyes with prior cataract extraction increased from the 70-79 years of age group (9.4% at 60-69 years of age and 38% at 70-79 years of age) and continued increasing in the 80-89 and ≥ 90 years of age groups (48% and 100%). The mean age of patients with RRD in phakic eyes was 53.0 ± 15.0 years (range, 6-89 years), and patients with RRD in eyes with prior cataract extraction was 63.3 ± 15.6 years (range, 19-95 years). In eyes with prior cataract extraction, the number of RRD cases increased from the 40-49 years of age group, with a peak in the 70-79 years of age group (12.0 per year), and then decreased thereafter (Figure 2).

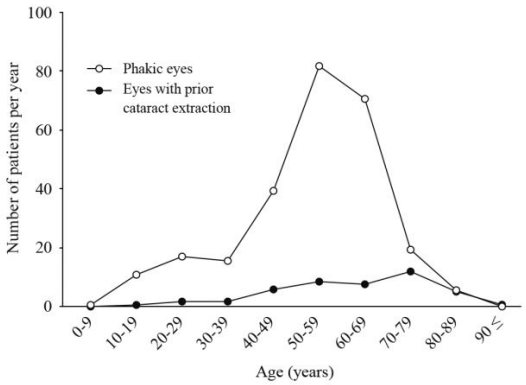

Figure 2: The annual number of rhegmatogenous retinal detachment cases in phakic eyes and eyes with prior cataract extraction.

Refraction

Of the 773 RRD in phakic eyes, myopia (≥ −1 diopter [D]) was found in 429 patients (55%). High myopia (≥ −6 D) was found in 183 patients (24%). In patients younger than 50 years of age, 85% (207/244) exhibited myopia, and 49% (120/244) exhibited high myopia. The mean refractive status in all patients was −3.53 ± 3.94 D (range, +4.0 to −18.0 D). In the subpopulations, myopia progressed in groups younger than 50 years of age, with a peak at 20-29 years of age (−7.21 ± 3.87 D; Figure 3). The mean refractive status in patients younger than 50 years of age (−6.00 ± 3.33 D) was significantly higher than that in patients ≥ 50 years of age (−2.23 ± 3.61 D; $P<0.001$). The mean refractive status was −3.68 ± 4.02 D in males and −3.29 ± 3.81 D in females. There were no marked differences in the sex distribution associated with refractive status ($P=0.28$).

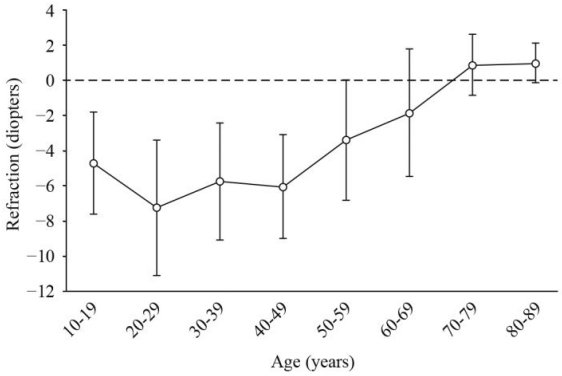

Figure 3: Refractive status in phakic eyes with rhegmatogenous retinal detachment.

Discussion

This study investigated the incidence and epidemiologic characteristics of primary RRD based on a retrospective chart review of hospital patients during the three-year study period. The results showed that the annual incidence of RRD in Kumamoto, Japan, between 2009 and 2011 was approximately 17 per 100,000 people. Previous studies have reported that the incidence of RRD was 7.98-18.2 per 100,000 people [1-7]. In ascending order, the incidence of RRD was 7.98 per 100,000 people in Beijing, China (1999-2000) [1]; 10.39 per 100,000 people in Korea (2007-2011) [2]; 10.4 per 100,000 people in Kumamoto, Japan (1990) [3]; 10.06-15.28 per 100,000 people in Scotland (1987-2006) [4]; 11.8 per 100,000 people in New Zealand (1997-1998) [5]; 17.9 per 100,000 people in Olmsted County, Minnesota, USA (1976-1995) [6]; and 18.2 per 100,000 people in the Netherlands (2009) [7]. The following have been suggested as possible causes of the variation in incidence rates: (1) The definition of RRD differs among studies; for example, some studies only included surgery-requiring RRD [2,7]. Patients treated by retinal photocoagulation or cryotherapy alone were not counted in the present study, but in other studies, all patients with RRD were counted, regardless of the therapeutic method [3-6]. In addition, there has been variation in the inclusion of traumatic retinal detachment, retinal detachment associated with macular hole, recurrent RRD, and RRD after intraocular surgery. (2) The demographic characteristics, such as age distribution, also differed among studies. In some previous studies, the incidences of RRD were higher in the elderly age group, with a peak at 50-79 years of age, than in younger subjects [1-7]. Similarly, the incidences of RRD were 18.2 and 13.2 per 100,000 people in the Netherlands [7] and Scotland [4], where 35% and 34% of the population were 50 years of age or older, respectively. In contrast, the

incidences of RRD were 7.9 per 100,000 people and 11.7 per 100,000 people in China [1] and New Zealand [5], where 25% and 23% of the population were 50 years of age or older, respectively.

We found a relatively high incidence of RRD in the present study compared with previous studies [1-7]. The advanced aging of Japanese society and the high prevalence of myopia in Japanese populations likely contributed to the high incidence of RRD. Japan currently has the most advanced aging society in the world [13] with 44% of the population ≥ 50 years of age in 2010. Because the peak incidence of RRD was recognized in the elderly population [1-7], the total incidence of RRD increased given the relatively elderly condition of the general Japanese population. Furthermore, the proportion of myopia (<−0.5 D) and high myopia (<−6 D) in those ≥ 40 years of age is 42% and 5.5% in the Japanese population [14]. This value is also the highest in the world. It has been reported that myopia, especially high myopia, is a major risk factor of RRD [9,10,15]. These two factors contributed to the high incidence of RRD in our study.

As in previous studies, the incidence of RRD had a strong association with age [1-7]. The most frequent peak incidence of RRD was reported at 60-69 years of age [1-3,5-7]. In our study, the peak incidence was found at 50-59 years of age. Retinal breaks characteristically develop during posterior vitreous detachment (PVD). Two factors have been found to be important in the onset of PVD: age and myopia. PVD occurs in 27% of those 60-69 years of age and 63% of those ≥ 70 years of age [16]. High myopia is likely to induce the development of PVD at an even earlier age [17], and the higher the degree of myopia, the younger the age of onset [18]. Because of the high prevalence of myopia in the Japanese population [14], the peak incidence of RRD in our study was slightly younger than that in previous studies.

Regarding the differences in the RRD incidence by sex, inconsistent results have been reported. Some studies reported that the incidence of RRD was lower in males than in females [3,19] while other studies found opposite results [1,2,4-7]. Our study found that the incidence of RRD was higher in males than in females, with no marked difference between the sexes in refractive status, which are risk factors of RRD. Ocular trauma was also a risk factor of RRD in males [7,20]. However, traumatic retinal detachment was not included in our study. Further studies are required to clarify why the incidence of RRD differs between males and females.

Cataract surgery is a major risk factor of RRD, due to the high rate of PVD after cataract extraction and a lower hyaluronic acid concentration causing vitreous collapse [21,22]. A previous study found that although only 2.4% of the population underwent cataract surgery, 43% of patients with RRD had a history of cataract extraction [23]. Higher life expectancy and advances in cataract surgery have contributed to the increase in the rate of cataract extraction [8]. In Sweden, 19% of RRD patients had prior cataract surgery between 1971 and 1981; 20 years later, the proportion of RRD patients with prior cataract surgery had increased to 31% [19,24]. Phacoemulsification is a safer technique than intracapsular cataract extraction (ICCE) or extracapsular cataract extraction (ECCE). Therefore, cataract extraction tends to be performed at relatively early stages [25,26]. However, it was reported that the risk of RRD with ICCE and ECCE was slightly higher than that with phacoemulsification (1.0%-8.1% with ICCE, 0%-7.5% with ECCE, and 0%-3.6% with phacoemulsification) [27]. In our study, the incidence of RRD in phakic eyes peaked at 50-59 years of age, while the incidence of prior cataract extraction peaked at 70-79 years of age. Cataract surgery is performed most frequently in septuagenarians [28], and the mean duration between cataract surgery and retinal detachment in patients using phacoemulsification was reported to be 26.5 months [11]. Therefore, the peak number of RRD patients tends to be older in eyes that have experienced prior cataract extraction.

	Total		Males		Females	
Age (years)	**1999**	**2009-2011**	**1999**	**2009-2011**	**1999**	**2009-2011**
0-9	0.9	0.2	0.0	0.4	0.9	0.0
10-19	5.0	6.0	4.5	8.0	5.5	3.8
20-29	10.3	10.0	8.4	11.4	12.0	8.7
30-39	5.5	7.5	5.6	11.0	5.4	4.2
40-49	7.7	20.8	8.1	28.0	6.9	14.3
50-59	15.6	35.4	15.5	42.7	15.7	28.4
60-69	22.7	31.6	18.1	41.9	26.3	22.2
70-79	18.9	15.3	17.8	24.6	19.6	8.4
80-89	6.4	8.2	0.0	12.0	8.3	6.1
Total	10.4	16.5	9.6	21.9	11.2	11.7
Data are expressed as annual incidences per 100,000 people						

Table 2: Comparison of incidence of rhegmatogenous retinal detachment in Kumamoto prefecture between 1990 [4] and 2009-2011.

The annual incidence of RRD in Kumamoto Prefecture was previously evaluated in 1990 [3]. Our result regarding the incidence from this more recent evaluation between 2009 and 2011 was approximately 1.6 times higher than that in 1990 as a previous study in

Scotland [4]. Regarding gender-specific incidence, the total incidence among males more doubled during the 20-year period (Table 2). The incidence was higher at all age groups, particularly higher among the patients who were 40-69 years of age. The incidence among females of 40-49 years of age groups had more than doubled. However, the incidence among females as a whole showed no change. Myopia contributed to the increase in the incidence of RRD in the middle-aged age groups because the prevalence of myopia and high myopia in Japanese has increased with time [14]. However, the difference in the rate of increase between males and females cannot be explained by myopia alone because there is no difference in the refraction status of males and females [14]. Further studies are required to clarify why the rate of increase differed between males and females.

The following have been suggested as possible causes of the higher total incidence in our study: (1) The aging of the population progressed in Japan; indeed, the ratio of those ≥ 50 years of age among the total population in Kumamoto increased rapidly from 32% to 39% over the past 20 years. (2) The increment of proportion of patients with a history of cataract surgery; a previous study found that 4.7% of RRD patients had a history of cataract surgery. In our study, that proportion was 14%. (3) In 2010, the male-to-female ratio in Kumamoto was 1.1 times the ratio in 1990 (0.87 in 2010, 0.79 in 1990). The higher ratio and the increased incidence of RRD in males contributed to the increase in the total incidence of RRD in our study.

Three limitations associated with the present study warrant mention. First, only surgery-requiring RRD was counted in our study. Patients treated by solely retinal photocoagulation or cryotherapy were not counted. Recently, laser treatment has been widely performed to treat early-stage RRD, so this might have influenced our findings. Second, we did not include any cases with traumatic retinal detachment in our study. Ocular trauma was reported to be a risk factor of RRD in males [7,20]. We therefore might have underestimated the incidence of RRD. Finally, there were slight differences in the inclusion criteria of our present study and the criteria of the previous study published in 1990. The increased rate of incidence may have been underestimated because patients treated by retinal photocoagulation or cryotherapy alone and patients with traumatic retinal detachment were not excluded in the previous study.

In conclusion, we investigated the incidence and epidemiologic characteristics of RRD in Kumamoto, Japan. During the current 20-year period, the incidence of RRD in Kumamoto was 1.6 times higher than the incidence reported in a previous study in 1990. In countries with a growing elderly population like Japan, the incidence of RRD will continue to increase. Therefore, the incidence of RRD must be investigated periodically.

Interests or Conflicts

None of the following authors have any proprietary interests or conflicts of interest related to this submission: AH, TK, TT, RI, HT.

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